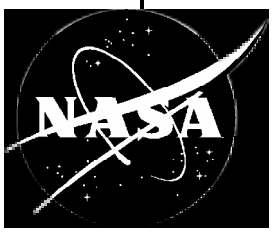
540-092

MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE

Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and Spacecraft Simulator (SSIM)

September 1997



National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and Spacecraft Simulator (SSIM)

September 1997

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Preface

This document is under the configuration management of the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division Configuration Control Board (CCB).

Proposed changes to this document shall be submitted to the Nascom CCB, along with supportive material justifying the change. Changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

Questions concerning this document and proposed changes shall be addressed to:

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Abstract

This Interface Control Document (ICD) describes interface agreements between the Spacecraft Simulator (SSIM) and Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet).

Keywords: *EBnet, ICD, Interface Control Document, Spacecraft Simulator, SSIM*

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Abbreviations and Acronyms

Section 1. Introduction

1.1 Authority and Responsibility

The Mission Operations and Data Systems Directorate (MO&DSD) has the authority to implement the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet). This authority was granted to MO&DSD by the EOS project under the Office of Mission to Planet Earth (Code Y). The EBnet project is under the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division of the MO&DSD.

Code 540 will provide an operational communications network to support high-speed network communications between EBnet and non-EBnet hosts. The primary responsibility for this project has been assigned to the Nascom Division, Code 540. The system requirements are documented by the references in Section 2.1.

1.2 Purpose

The purpose of the interface between the Spacecraft Simulator (SSIM) and EBnet is to support connectivity between the SSIM and the EOSDIS Test System (ETS) as well as connectivity between the SSIM and the EOS Operations Center (EOC). The SSIM-to-ETS data flows require a Nascom clock and data service. The SSIM-to-ETS interface supports simulation and training and is not considered to be mission critical. The SSIM-to-EOC data flows require EBnet Internet Protocol (IP) support. All data flows between the SSIM and EOC supported by EBnet are considered to be science traffic [for purposes of EBnet Interface Control Document (ICD), any traffic type which is not real time is considered to be science traffic.] It is important to note that the SSIM initially resides at Valley Forge, Pennsylvania (VFPA) and is then delivered to the EOC facility. Both types of interface (IP and clock and data) are required at both locations. It is also important to note that the clock and data service from VFPA supporting the SSIM is shared on a non-interference basis with the Spacecraft Checkout Station (SCS). After the SSIM is transferred to the EOC facility, it does not require connectivity to the EBnet wide area links.

1.3 Scope

This ICD defines and controls the functions, communications protocol(s), frame formats, and electrical characteristics of the interfaces between EBnet-provided equipment, software, and communications paths and other entities that directly interface with the network. Interfaces provided by Nascom are included in the scope of this document. Interfaces between EBnet users and other systems not provided by Nascom are not within the scope of this document.

1.4 Time Frame

This ICD shall be in effect from the date of the last approval signature.

1.5 Goals and Objectives

The goals of EBnet are to:

a. Implement an operational, integrated, transparent communications system that serves the data communications needs of projects supported by NASA Goddard Space Flight Center (GSFC), and users outside the MO&DSD.

b. Expand using industry standard system solutions while maintaining compatibility with the existing network and user interfaces.

c. Minimize costs for implementation, operation, and maintenance of the network.

d. Minimize life-cycle costs.

e. Maintain high availability by designing with redundancy, and without single points of failure in the Network Backbone, where required.

f. Utilize state-of-the-art technology, utilizing equipment with the best price-performance available commercially.

g. Allow for growth, adaptability to changing requirements, infusion of new technology, and upgraded interfaces throughout the life-cycle.

1.6 Standards Precedence

EBnet will be based on Government, commercial, and international standards. In case of conflict, the following precedence (in descending order) applies:

- This EBnet ICD.
- Government standards.
- Commercial and/or international standards.

1.7 Document Organization

Section 2 contains parent, applicable, and reference documents related to this ICD.

Section 3 details a systems overview of the EBnet, SSIM, and the interrelationship.

Section 4 presents a detailed design of the clock and data interface at VFPA and GSFC.

Section 5 presents a detailed design of the IP interface at VFPA.

Section 6 describes the facilities and maintenance demarcation.

An appendix is used to describe the SSIM IP interface after its relocation to GSFC from VFPA.

A list of abbreviations and acronyms is provided at the end of the document.

Section 2. Related Documentation

2.1 Parent Documents

[1] *Earth Observing System AM-1 Detailed Mission Requirements*, Goddard Space Flight Center (GSFC), 505-10-33, November 1996

[2] *Earth Science Data Information System (ESDIS) Project Level 2 Requirements Volume 6, EOSDIS Backbone Network (EBnet) Requirements*, Goddard Space Flight Center (GSFC) 505-10-01-6, Revision A, December 1996

[3] *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Interface Requirements Document (IRD)*, September 1997

[4] Reserved

2.2 Applicable Documents

[5] *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*, Electronic Industries Association (EIA) 422-A, December 1978

[6] *General-Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, EIA 449, November 1977

[7] *Internet Protocol (IP): DARPA Internet Program Protocol Specification*, Request for Comment (RFC) 791, September 1981

[8] *The Point-to-Point Protocol (PPP)*, RFC 1661, July 1995

[9] *An Ethernet Address Resolution Protocol or Converting Network Protocol Addresses to 48-bit Ethernet Addresses for Transmission on Ethernet Hardware*, RFC 826, November 1982

[10] *Internet Control Message Protocol*, RFC 792, September 1981

[11] *Routing Information Protocol (RIP)*, RFC 1058

[12] *Open Shortest Path First (OSPF)*, RFC 1247

[13] *Internet Group Multicast Protocol (IGMP)*, RFC 1112

[14] *On the Assignment of Subnet Numbers*, RFC 1219

[15] *Simple Network Management Protocol (SNMP)*, RFC 1157

[16] (reserved)

[17] *A Reverse Address Resolution Protocol (RARP)*, RFC 903

[18] *Internet Protocol on Ethernet Networks*, RFC 894

[19] *Transmission of IP over FDDI*, RFC 1188

[20] *Structure of Management Information*, RFC 1155

[21] *Management Information Base - II*, RFC 1213

[22] *Transmission Control Protocol*, RFC 793

[23] *Telnet Protocol*, RFCs 854 & 855

[24] *File Transfer Protocol*, RFC 959

[25] International Organization for Standardization (ISO) 9314-1, *FDDI Physical Layer Protocol (PHY)*

[26] ISO 9314-2, *FDDI Media Access Control (MAC) Protocol*

[27] ISO 9314-3, *FDDI Physical Layer Medium Dependent (PMD)*

[28] ISO 8802-2, *Logical Link Control (LLC)*

[29] ISO 8802-3, *Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet version 2*

[30] Institute of Electrical and Electronic Engineers (IEEE) 802.3 *10Base-T (twisted pair)*

[31] IEEE *10Base5 (thick ethernet)*

[32] International Telegraph and Telephone Consultative Committee (CCITT) *V.35*

2.3 Reference Documents

[33] *NASA Communications (Nascom) Access Protection Policy and Guidelines*, 541-107, Revision 3, GSFC, November 1995

[34] *NASA Communications System Acquisition and Management*, NASA Management Instruction (NMI) 2520.1D, National Aeronautics and Space Administration (NASA), November 18, 1991

[35] *Nascom IONET Users Guide*, 541-225, Revision 1, April 1996

[36] *Interface Requirements Document between the Earth Observing System Data and Information System (EOSDIS) and the AM Project for AM-1 Flight Operations*, 505-41-15, GSFC, July 1995

Section 3. Systems Overview

3.1 EBnet General System Description

The EBnet provides wide-area communications circuits and facilities between and among various EOS Ground System (EGS) elements to support mission operations and to transport mission data between EOSDIS elements. The relationship of EBnet to other elements supporting EOS is shown in Figure 3-1. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. The EBnet capability to transport these diverse types of data is implemented as two distinct subnetworks referred to as "real-time" and "science" networks. The real-time network transports mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as pre-launch testing and launch support. This highly redundant network provides an operational availability of 0.9998 with a Mean Time to Restore Service (MTTRS) of 1 minute. The science network transports data collected from spacecraft instruments and various levels of processed science data including expedited data sets, production data sets, and rate-buffered science data. The science network provides an operational availability of 0.98 with a MTTRS of 4 hours.

EBnet provides three options for accessing the IP-based EBnet transport service: Local Area Network (LAN) Ethernet, LAN Fiber Distributed Data Interface (FDDI), and Wide Area Network (WAN) carrier service. Figure 3-2 shows an example of each of these types of interface/demarcation points to EBnet users. Additionally, EBnet will support serial clock and data interfaces with the user system as is the case with the SSIM interface. This ICD describes the EBnet/SSIM interface which employs serial clock and data installations and an ethernet LAN interface for the VFPA and the EOC at GSFC. The clock and data interface at VFPA and GSFC is described in Section 4; the LAN/WAN interface at VFPA is described in Section 5; and the LAN interface for SSIM at the EOC site (GSFC) is described in the Appendix.

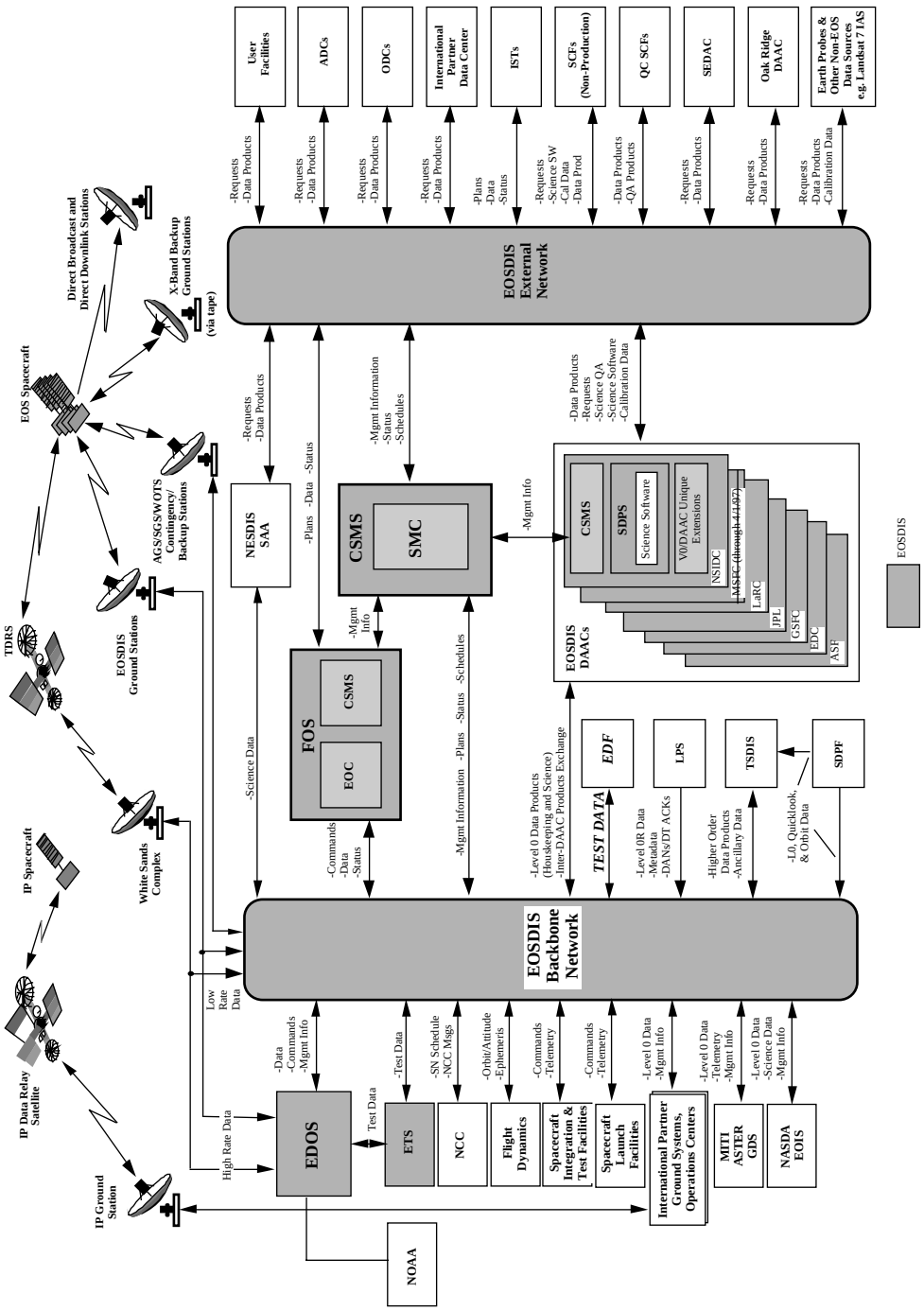

Figure 3-1. EOS Ground System

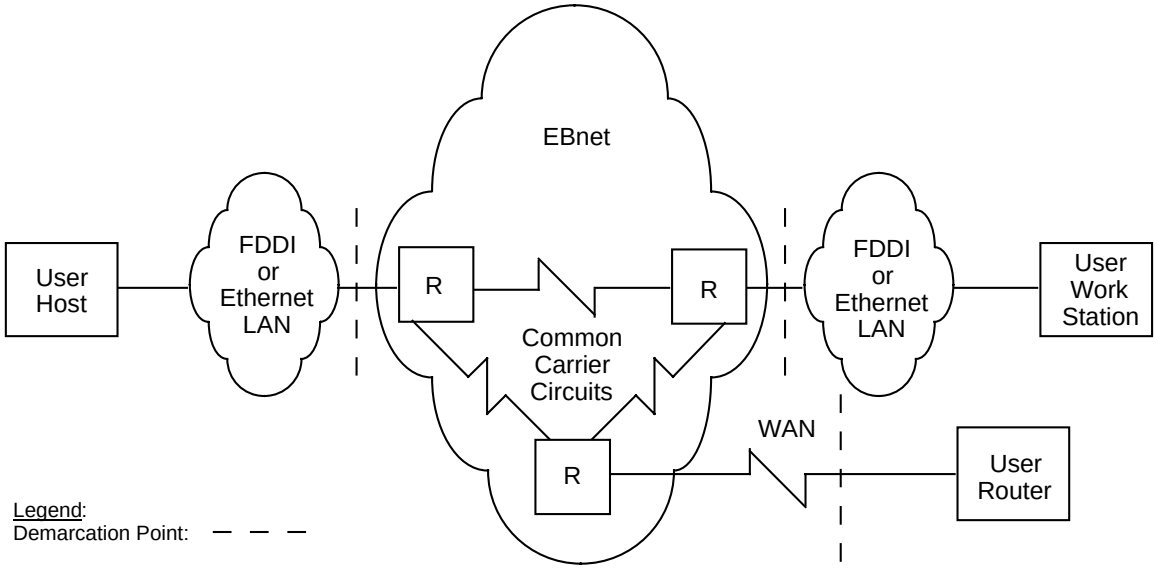

Figure 3-2. EBnet Demarcations

Sustaining engineering, preventive and remedial maintenance, and network monitoring services are provided for EBnet equipment, to ensure that EBnet keeps pace with technology and standards, and provides continuous service. The official point of contact for EBnet operational status is the Nascom Communications Manager (COMMGR) (301-286-6141). Users who detect a network problem are urged to immediately report it to the COMMGR. The COMMGR may also provide users with limited information about maintenance and status actions. Refer to the Nascom IP Operational Network (IONET) User Guide (541-225) for information regarding user connections, security guidelines, and maintenance information.

3.2 SSIM Description

The SSIM is initially located at the Lockheed Martin (LM) contractor's facility in VFPA. The function of this workstation is to simulate the performance of the AM-1 spacecraft in the factory and later at the EOC after the spacecraft has been relocated to the Vandenberg Air Force Base (VAFB) launch facility.

3.3 Relationship Between EBnet and SSIM

EBnet provides the transport media for the transmission of operational data between the EOC at GSFC and the SSIM for the purpose of testing and verifying the AM-1 satellite. Initially, the SSIM will be located at the LM contractor's facility in VFPA. When the spacecraft is relocated to the VAFB launch site, the SSIM will be relocated to the EOC at GSFC. EBnet interfaces enable the SSIM to interface with the ETS while the SSIM is located at VFPA.

Section 4. Interface Detailed Design

4.1 Clock and Data Interface Design Overview

EBnet/SSIM interface design is based on the requirement to transport three variable rate data streams on three discrete serial clock and data channels between the SSIM and the ETS while the SSIM is located at VFPA. When the SSIM moves to GSFC, EBnet is no longer responsible for connectivity between the SSIM and the ETS. EBnet has selected a Timeplex T1 multiplexer to transport digital signals to and from the SSIM. Figure 4-1 provides an end-to-end depiction of the circuit between the SSIM and GSFC.

4.2 Design Assumptions

EBnet has made the following assumptions, each of which influences the design:

a. The only type of interface with EBnet required by the SSIM for WAN data transport is serial clock and data.

b. The data rates to be supported at the SSIM/EBnet interface are channelized as follows (Any one of the indicated rates may be present on the line at any given time. The multiplexer channel must have the capability to accept data rate changes between the listed frequencies on an automatic basis.):

   1. Telemetry Line 1: 1 kilobit per second (kbps) or 16 kbps, simplex, transmit only at the SSIM.

   2. Telemetry Line 2: 1 kbps, 16 kbps, 256 kbps, or 512 kbps, simplex, transmit only at the SSIM.

   3. Command: 0.125 kbps, 1 kbps, 2 kbps, or 10 kbps, simplex, receive only at the SSIM.

NOTE

Each of the lines will produce or receive clock and data via RS-422 standards over RS-449 interfaces.

c. The SSIM will first be located at the contractor's facilities in VFPA. Upon completion of activities there, the SSIM will be relocated to the EOC facility at GSFC.

d. The SSIM requires data communication with the EOC at GSFC.

e. Since EBnet supplies the multiplexers for each end of the data link's path, inclusion of the individual modules and the firmware versions to be employed is not required for this ICD.

f. The physical interface for the command signal is a fully compliant RS-449 37-pin D connector.

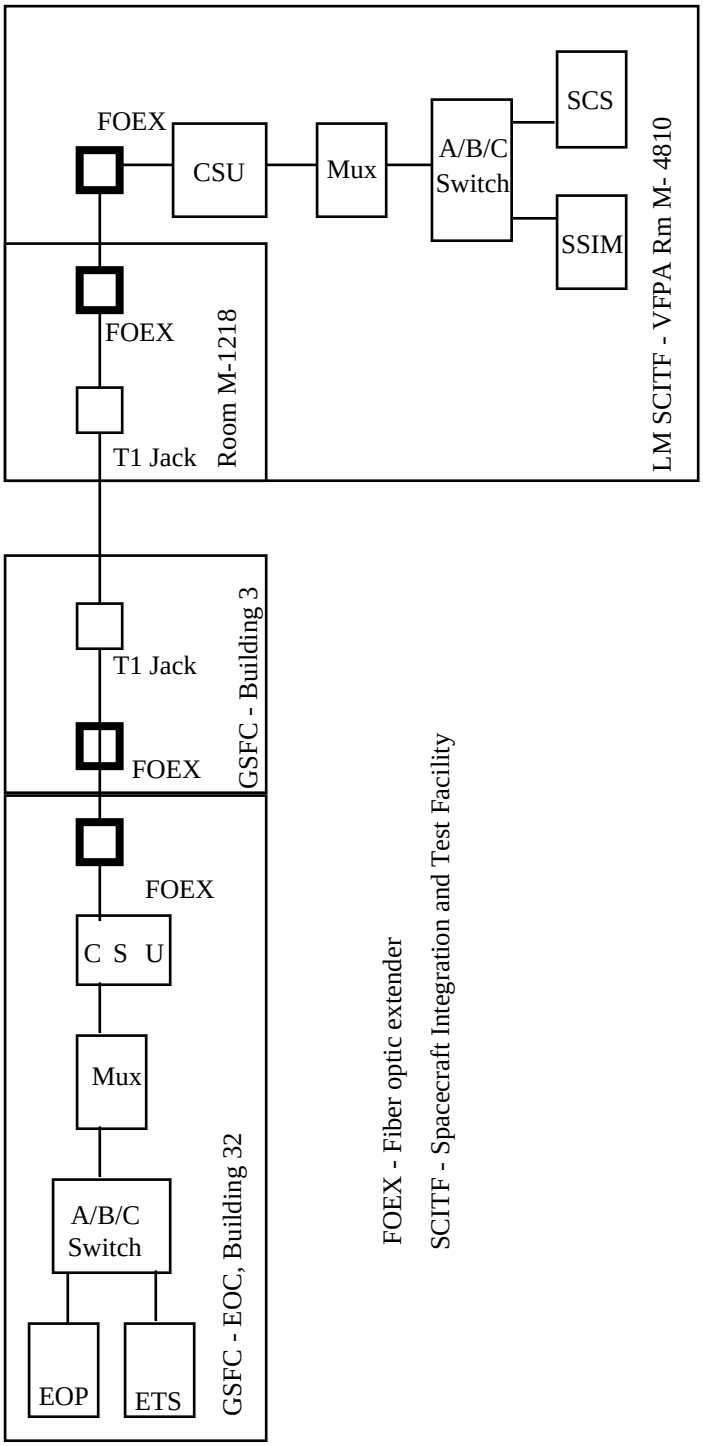

Figure 4-1. End-to-End Circuit between GSFC and SSIM Site Locations

g. The three data lines must be switchable between one set of interfaces with the SSIM and an identical set of interfaces with the SCS, also located at the LM VFPA facility.

4.3 Data Interface Design

The data signals to be transported will employ a Timeplex Corporation T-1 intelligent time-division multiplexer. Because the three data lines to be transported must be capable of being manually switched between either the SSIM or the SCS at the VFPA site, EBnet will include an A/B switch specifically configured to perform this function in its design.

At the SSIM VFPA site, the EBnet equipment will be mounted in its own equipment cabinet. In the bottom of the equipment cabinet EBnet will provide a (bulkhead) connector interface panel. This connector interface panel constitutes the demarcation point between the SSIM and EBnet. EBnet is responsible for the multiplexer side of the panel. Everything on the SCS side of the panel is an SSIM responsibility, including cabling up to the panel and connecting to it.

Because some of the data rates to be supported are custom, the multiplexer (MUX) equipment vendor is supplying a special data channel module for transport of the SSIM data signal.

Figure 4-2 provides a representation of the EBnet/SSIM interface. Reference Section 4.7.

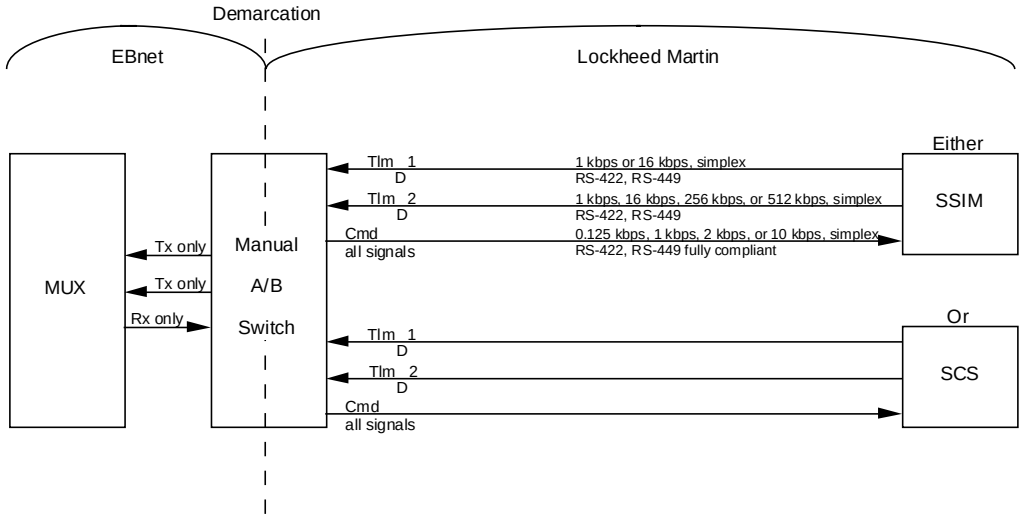

Figure 4-2. EBnet/SSIM Interface

4.3.1 Electrical Interfaces

The electrical interfaces between the multiplexer channel and the SSIM shall conform to the Electronic Industries Association's (EIA's) RS-422 standard [5] for each of the three data lines.

4.3.2 Physical Interfaces

For the command data lines, the physical interface between the multiplexer channel and the SSIM shall conform, in all respects, to the EIA's RS-449 standard [6].

4.4 Performance

The EBnet/SSIM interface shall meet the following performance specifications detailed below.

4.4.1 Data Rates

Data rates to be supported are data line specific and are stated here.

a. Telemetry Line 1: 1 kbps or 16 kbps, simplex, transmit only at the SSIM (assume the interface to be wholly compliant with the RS-449 37-pin D connector option).

b. Telemetry Line 2: 1 kbps, 16 kbps, 256 kbps, or 512 kbps, simplex, transmit only at the SSIM (assume the interface to be wholly compliant with the RS-449 37-pin D connector option).

c. Command: 0.125 kbps, 1 kbps, 2 kbps, or 10 kbps, simplex, receive only at the SSIM (assume the interface to be wholly compliant with the RS-449 37-pin D connector option).

4.4.2 Timing

The multiplexers will be configured to operate on a master (GSFC) - slave (SSIM) basis. The communication common carrier will supply the timing signal for system timing.

4.4.3 Restoral

Since this is not a real-time service, the system design will support a MTTRS of 4 hours.

4.5 On-line Configuration Management

The MUX will be operated in the master - slave mode with the master station's functions being performed by GSFC.

4.6 Maintenance and Operation Management

The Timeplex multiplexer is of a modular architecture. When a failure is diagnosed by the EBnet network management function as being in a module of the SSIM MUX, then LM site personnel at the SSIM will be asked by the EBnet Network Management Operator to remove the failed module and replace it with an EBnet provided spare. If the fault cannot be resolved by the simple act of module replacement, then the Network Management Operator will dispatch a technician from the servicing vendor.

4.7 Equipment List

EBnet will provide the following equipment to support this interface:

a. Multiplexer: Timplex (Model Link/2+).

b. A/B Switch: South Hills Data Comm (Model RS-449).

Section 5. IP Interface Detailed Design

5.1 IP Interface Design Overview

The EBnet/SSIM interface design is based on the requirement to transport software data between EOC and the SSIM. Initially, the EBnet design provides the WAN segment between the EOC and SSIM utilizing the resources of the Program Support Communication Network-Internet (PSCNI). The SSIM will then be moved to GSFC as shown in the Appendix. Figure 5-1 represents the interface with the SSIM located at VFPA.

5.2 Design Assumptions

a. The type of interface that will be required in addition to the clock and data specified in Section 4 is an IP (both for LAN and WAN segments).

b. The data rate to be supported will be 56 kbps for both incoming and outgoing data.

c. The SSIM will initially be located at the spacecraft vendor's facilities at VFPA.

d. The PSCNI backbone will be available for transport of the WAN segment of the SSIM interface.

5.3 Data Interface Design

The following information is known about the design of the data interface for the SSIM at both VFPA and, later, at GSFC. Routers provide the data communication interfaces. The protocols for each layer are described in the following paragraphs.

The following sections detail the standards that will be supported at each level of the ISO seven-layer model.

5.3.1 ISO Layer One Interface Control (Physical Layer)

EBnet will support the following physical layer connections:

a. IEEE 802.3 10BaseT (unshielded twisted pair) with RJ45 connectors.

b. IEEE 10Base5 (thick ethernet, RG-8 coax, 50 ohm impedance) with 15-pin connector.

c. ISO 9314-1, FDDI Physical Layer Protocol (PHY).

d. ISO 9314-3, FDDI Physical Layer Medium Dependent (PMD).

e. CCITT V.35 for speeds above 19.2 kbps.

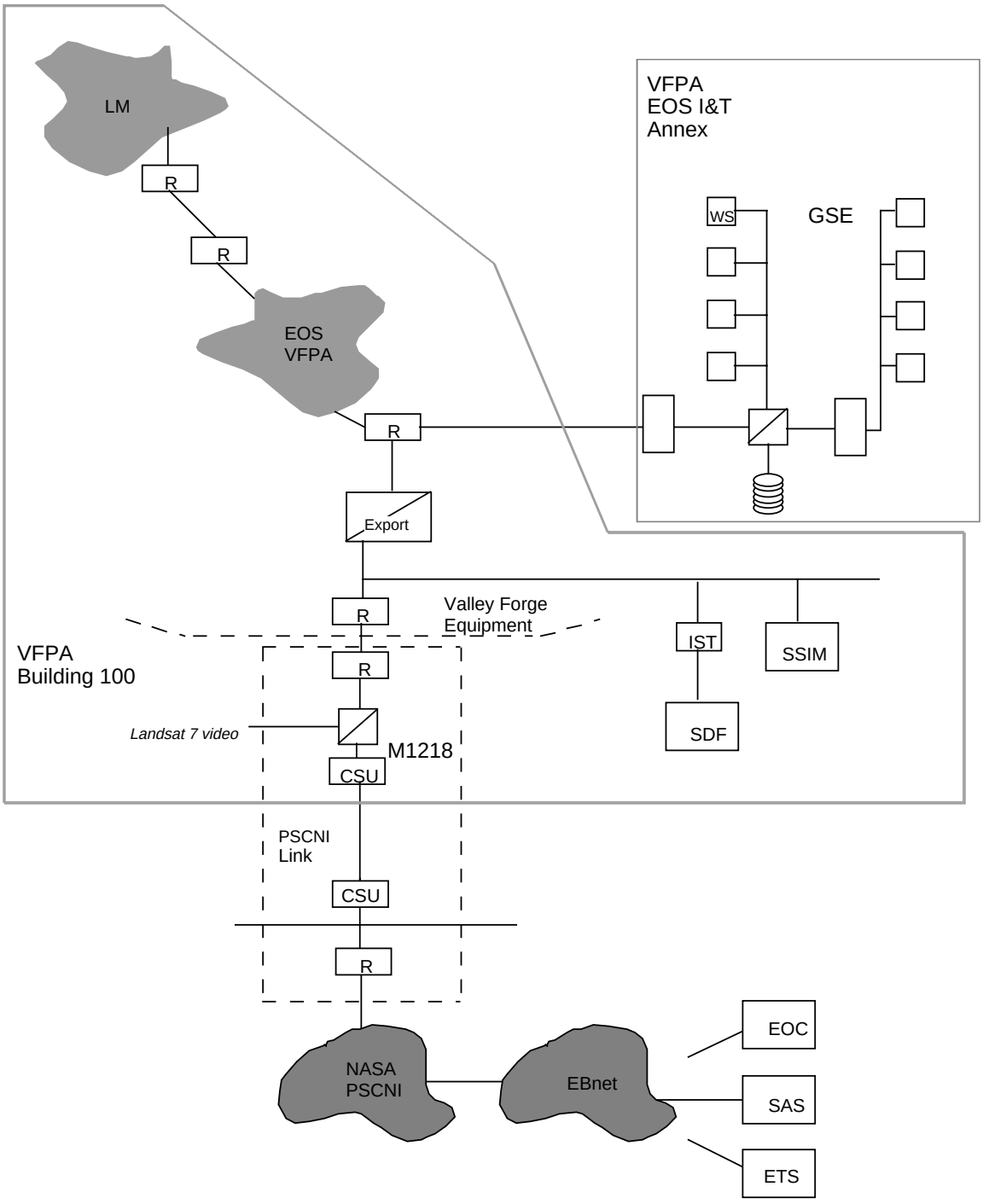

Figure 5-1. EOC/SSIM Interface Overview (Reflects IP Interfaces Only)

f. EIA RS-422 for speeds above 19.2 kbps.

5.3.2 ISO Layer Two Interface Control (Data Link Layer)

EBnet will support the following data link layer protocols:

a. ISO 802.2, LLC.

b. ISO 8802-3, CSMA/CD MAC - Ethernet Version 2.0 is supported.

c. ISO 9314-2, FDDI MAC Protocol.

d. Point-to-Point Protocol (PPP) [8].

e. Cisco Proprietary High-level Data Link Control (HDLC).

5.3.3 ISO Layer Three Interface Control (Network Layer)

EBnet will support the following network layer protocols:

a. Request for Comment (RFC) 791, Internet Protocol Version 4.0.

b. RFC 1157, Simple Network Management Protocol (SNMP).

c. RFC 826, Address Resolution Protocol (ARP).

d. RFC 903, A Reverse Address Resolution Protocol (RARP).

e. RFC 1058, Routing Information Protocol (RIP).

f. RFC 1247, Open Shortest Path First (OSPF).

5.3.4 ISO Layer Four Interface Control (Transport Layer)

EBnet will support transparent communication at the transport layer.

5.3.5 ISO Layer Five Interface Control (Session Layer)

EBnet will support transparent communication at the session layer.

5.3.6 ISO Layer Six Interface Control (Presentation Layer)

EBnet will support transparent communication at the presentation layer.

5.3.7 ISO Layer Seven Interface Control (Application Layer)

EBnet will support transparent communication at the application layer.

5.3.8 Network/Station Management Protocols

EBnet shall support, at a minimum, the following management protocols:

a. SNMP.

b. FDDI Station Management (SMT) 6.2 or higher.

5.4 Routing and Addressing Guidelines

EBnet will be internetworked by routers and switches which will be configured to support only the IP, and will provide isolation for separate networks. Cisco 7500 routers and Bay Network routers have been chosen to provide network access to users.

EBnet will utilize standard IP addressing conventions. SSIM will utilize a pre-assigned address from an existing block of IP addresses at VFPA.

5.5 Data Flow Requirements

The EBnet/SSIM interface shall meet the following performance specifications:

a. Data rate: 56 kbps.

b. Restoral: Since this is not a real-time interface, the EBnet system design will support a MTTRS of 4 hours.

At the VFPA facility the SSIM while connected to the EOS Isolation network will comply with the LM Network Security requirements. This policy is enforced by the use of a Firewall (router/filter/EOS-export) which blocks all traffic between the GSFC EBnet node and the protected LM/EOS network, but still permits users on the protected EOS network to carry out basic File Transfer Protocol (FTP)/Telnet operations.

5.6 Equipment List

EBnet will provide the following equipment to support this interface:

a. Routers: Cisco (Model 7513).

b. Router: Bay Networks Router (Model BCN).

Section 6. Facilities and Maintenance Demarcation

6.1 Equipment Location

EBnet will interface to the SSIM located in Building 100 Integration and Test (I&T) Annex at VFPA. EBnet equipment will be located in Room M-4810 at a space to be provided. The customer will be responsible for extending link from AT&T smart jack to EBnet CSU/DSU (reference Figure 4-1).

6.2 Maintenance Demarcation

The demarcation point between EBnet maintenance and customer maintenance is the connection at the Data Comm A/B Switch. The user is responsible for cables to the EBnet demarcation.

Appendix. SSIM IP Interface at GSFC

A.1 Interface Design Overview

When the SSIM is relocated from the LM facility in VFPA to the EOC facility at GSFC, it will interface to the EBnet via an Ethernet LAN. WAN interfacing will not be required. Figure A-1 provides a high-level block diagram of the SSIM IP interface at GSFC. Details of this LAN interface are to be supplied for Release B support.

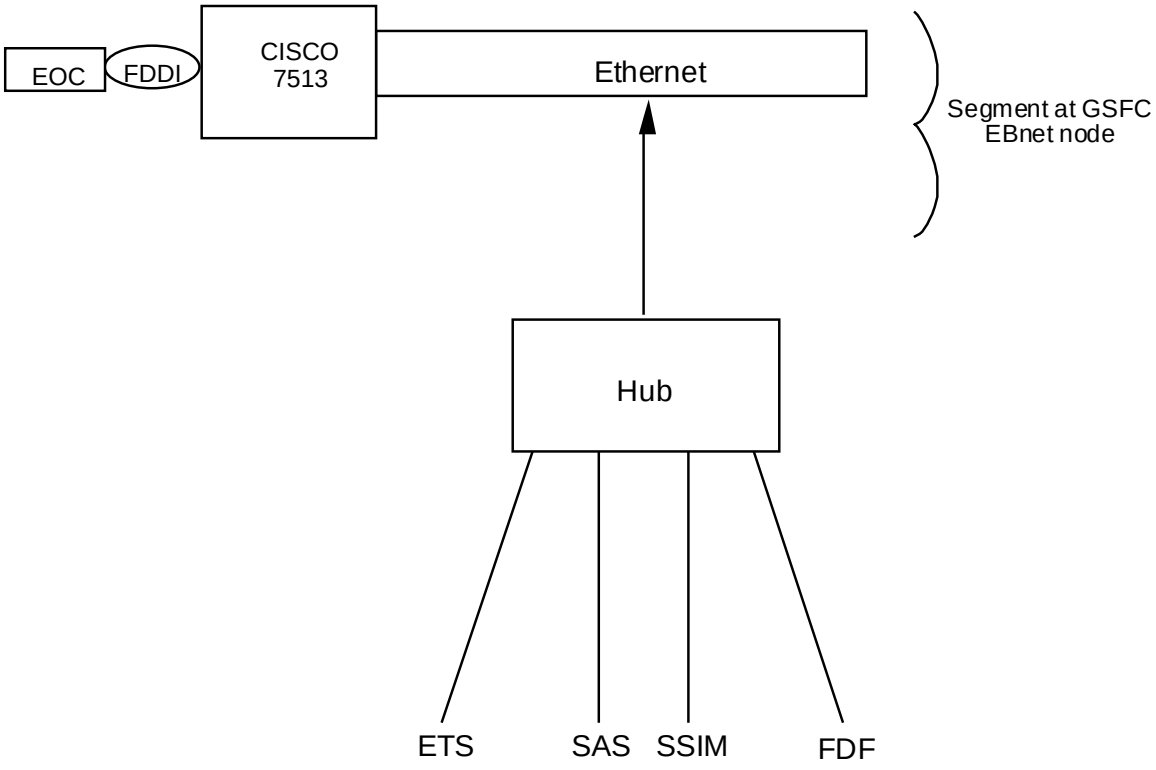

Figure A-1. SSIM LAN Interface at EOC

A.2 Data Interface Design

The following information is known about the design of the data interface for the SSIM at GSFC.

A.2.1 Primary Communication, Router Interface

A router will provide the data communication interface for the primary service.

The following sections detail the standards that will be supported at each level of the ISO seven-layer model.

A.2.1.1 ISO Layer One Interface Control (Physical Layer)

EBnet will support the following physical layer connections:

a. IEEE 802.3 10BaseT (unshielded twisted pair) with RJ45 connectors.

b. IEEE 10Base5 (thick ethernet, RG-8 coax, 50 ohm impedance) with 15-pin connector.

c. CCITT V.35 for speeds above 19.2 kbps.

d. EIA RS-422 for speeds above 19.2 kbps.

A.2.1.2 ISO Layer Two Interface Control (Data Link Layer)

EBnet will support the following data link layer protocols:

a. ISO 802.2, LLC.

b. ISO 8802-3, CSMA/CD MAC - Ethernet Version 2.0 is supported.

A.2.1.3 ISO Layer Three Interface Control (Network Layer)

EBnet will support the following network layer protocols:

a. RFC 791, Internet Protocol Version 4.0.

b. RFC 1157, SNMP.

c. RFC 826, ARP.

d. RFC 903, RARP.

e. RFC 1058, RIP.

f. RFC 1247, OSPF.

A.2.1.4 ISO Layer Four Interface Control (Transport Layer)

EBnet will support transparent communication at the transport layer.

A.2.1.5 ISO Layer Five Interface Control (Session Layer)

EBnet will support transparent communication at the session layer.

A.2.1.6 ISO Layer Six Interface Control (Presentation Layer)

EBnet will support transparent communication at the presentation layer.

A.2.1.7 ISO Layer Seven Interface Control (Application Layer)

EBnet will support transparent communication at the application layer.

A.2.1.8 Network/Station Management Protocols

EBnet shall support, at a minimum, the following management protocols:

a. SNMP.

A.3 Routing and Addressing Guidelines

EBnet will be internetworked by routers and switches which will be configured to support only the IP, and will provide isolation for separate networks. Cisco 7513 and Bay Network BCN routers have been chosen to provide network access to users.

EBnet will utilize standard IP addressing conventions. EBnet will provide a Class C subnet address to each connected user that requests one. The address assigned to SSIM will be supplied from a pre-existing block of IP addresses assigned to VFPA and GSFC. (The SSIM will utilize a VFPA IP address while at VFPA and a GSFC IP address while at GSFC.)

Abbreviations and Acronyms

ARP	Address Resolution Protocol
CCB	Configuration Control Board
CCITT	International Telegraph and Telephone Consultative Committee
COMMGR	Communications Manager
CSMA/CD	Carrier-Sense Multiple-Access with Collision Detection
DCN	Document Change Notice
EBnet	EOSDIS Backbone Network
EDF	ECS Development Facility
EIA	Electronic Industries Association
EOC	EOS Operations Center
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
ETS	EOSDIS Test System
FDDI	Fiber Distributed Data Interface
FTP	File Transfer Protocol
GSFC	Goddard Space Flight Center
HDLC	High-level Data Link Control
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronic Engineers
IGMP	Internet Group Multicast Protocol
IONET	IP Operational Network
IP	Internet Protocol
IRD	Interface Requirements Document
ISO	International Organization for Standardization
LAN	Local Area Network
LLC	Logical Link Control
LM	Lockheed Martin

MAC	Media Access Control
MO&DSD	Mission Operations and Data Systems Directorate
MTTRS	Mean Time to Restore Service
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NMI	NASA Management Instruction
OSPF	Open Shortest Path First
PHY	Physical Layer Protocol
PMD	Physical Layer Medium Dependent
PPP	Point-to-Point Protocol
PSCNI	Program Support Communication Network-Internet
RARP	Reverse Address Resolution Protocol
RFC	Request for Comment
RIP	Routing Information Protocol
SCS	Spacecraft Checkout Station
SMT	Station Management
SNMP	Simple Network Management Protocol
SSIM	Spacecraft Simulator
VAFB	Vandenberg Air Force Base
VFPA	Valley Forge, Pennsylvania
WAN	Wide Area Network